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Enhancing the piezoelectric coefficient of SrTiO3 nanocubes and PVDF film deposited by supersonic spraying for energy-harvesting nanogenerators

Abstract: Many perovskites and their piezoelectric composites have been investigated for harvesting ambient mechanical energy over the past two decades; however, the prospects for their commercialization appear remote because of several practical challenges. Therefore, highly scalable supersonic cold-spraying technology was used to fabricate flexible piezoelectric films of poly(vinylidene fluoride) (PVDF) and a novel perovskite SrTiO3 (ST). Substantial shear stress was exerted on PVDF during cold spraying owing to the hydrothermally synthesized SrTiO3 nanocubes and supersonic velocity, and the resulting film delivered an effective piezoelectric coefficient (69.6 pm·V-1) as confirmed by piezo-response force microscopy. As a result, the piezoelectric nanogenerator yields a maximum power of 130 μW at a load resistance of 0.9 MΩ. The composite film exhibited durability for 21,000 tapping cycles with 20 N applied force and 7 Hz frequency. The flexibility endurance was confirmed from 3000 bending cycles, and bending PENG attached to knee delivered 1 and 2.3 V on bending to 45 and 90°, respectively. After electrical poling, the PENG was subjected to a 20 N tapping force that yielded a piezopotential of 31 V. To the best of our knowledge, this is the first time piezoelectricity was obtained using an ST/PVDF composite via mechanical energy harvesting. The flexible PENG film deposited by cold-spraying shows good potential for wearable self-powered devices.

Keywords: SrTiO3, PVDF, Piezocomposite, Nanogenerator

Biography: Jungwoo Huh is a Mechanical Engineering student at Korea University, specializing in heat transfer, fluid dynamics, and energy storage. Over six semesters, he has focused on advanced research in supercapacitors, lithium-ion batteries, and piezoelectric materials. His work involves developing micro/nano fibers and coatings using innovative techniques like electrospinning, electroplating, and supersonic flow coating. The primary goal of his research is to improve the efficiency of energy storage devices beyond current standards.

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